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Geometry and Energy in Effective Field Theories

Saturday 16 November 2024 16:00 (20 minutes)

The geometry of field space governs on-shell scattering amplitudes in effective field theories. Extending previous geometric descriptions for scalars and gauge fields, I will discuss how we developed a framework that incorporates fermions into the geometric formulation of effective field theories. Utilizing this field-space geometry, we reorganize and simplify quantum loop corrections, calculating the one-loop contributions to the renormalization group equations for bosonic operators in the SMEFT up to mass dimension eight. I will further discuss structures in EFT not captured by the geometric framework, namely energy-enhanced effects arising from higher-dimensional operators. In particular, I will present our study on Higgs boson production via VBF at the LHC, and capturing the leading energy-enhanced contributions within the SMEFT up to mass dimension eight. Employing energy-scaling arguments, we predict the magnitude of each higher-dimensional operator's contribution and incorporate dimension-eight operators not previously considered. Our findings suggest that dimension-eight operators can have significant effects in regimes where the SMEFT remains valid for lower cutoff scales than expected.

Primary author: Dr ASSI, Benoît (U. Cincinnati)

Presenter: Dr ASSI, Benoît (U. Cincinnati)

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